U.S. Environmental Protection Agency, Region 4

Proposal

Everglades Ecosystem Assessment: Everglades Stressor Interactions- Water Quality, Mercury Contamination, Hydropattern, Soils, Eutrophication and Habitat -May 2013 thru April 2018

Principal Investigator/
(Cooperator):
Peter Kalla, Ph.D.
Everglades Ecosystem Assessment
Program Leader
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Region 4 Laboratory
980 College Station Road
Athens, GA 30605
kalla.peter@epa.gov
706-355-8778

Park Representative:
(or ATR)
Donatto Surratt, Ph.D.
Ecologist
Everglades National Park
Donatto_surratt@nps.gov
561-735-6003

Fiscal Year of Funding: FY 2013

Project Period: May 2013 thru April2018

Total Funding Not to Exceed: $200,000

Existing INTERAGENCY AGREEMENT NO: IA # P13PG7---

EFFECTIVE DATES: May 1, 2013 – April30, 2018

Project Objective:

The overall project objectives are to:

(1) contribute to the Comprehensive Everglades Restoration Plan by monitoring the conditions and trends in the Everglades ecosystem;

(2) assess the effects and potential risks due to mercury methylation and bioaccumulation in the ecosystem and interactions with eutrophication, hydropatterns, and habitat alteration;

(3) assess the effects and potential risks from environmental stresses, such as hydropattern modification, habitat alteration, mercury and phosphorus loading, and eutrophication, on the Everglades ecosystem;

(4) apply an improved monitoring design and ecological assessment protocol for evaluating the relative risks of environmental stressors action on the Everglades ecosystem; and

(5) provide scientifically credible information on a regular basis that contributes to management decisions on Everglades restoration issues.

PROPOSAL

Background

Phases 1/IVIII: Since 1993, the U.S. Environmental Protection Agency, Region 4 (EPA) has been conducting a landscape-level assessment of the Florida Everglades ecosystem in association with many partners, including Everglades National Park (Park). The Program uses EPA's Environmental Monitoring and Assessment Program (EMAP) statistical survey design to sample all of the Marl Prairie/Rocky Glades and the Everglades Ridge and Slough physiographic regions, which make up the central Everglades flow-way (Figure 1). The Everglades Ecosystem Assessment [EEA, formerly known as Everglades Regional EMAP (R-EMAP)] is the only comprehensive monitoring and assessment program that preceded the development of the Comprehensive Everglades Restoration Program (CERP), which subsequently defined several monitoring and assessment objectives to include: documenting status and trends, determining baseline variability, detecting responses to management actions, and improving the understanding of cause and effect relationships. The EEA has provided this information system- wide for the entirety of the freshwater Everglades. In Phases I (1993-1996) and II (1999) EPA provided pre-2000 baseline conditions for a broad array of indicators against which future changes can be measured. In Phase III (2005) changes were detected in mosquitofish mercury burdens and soil phosphorus concentrations. Project reports containing implications for CERP managers, as well as all program data and metadata, can be found at http://www.epa.gov/region4/sesd/sesdpub_completed.html, under South Florida Reports. EEA Program data have been featured in about 25 peer-reviewed publications and cited in about 100 others to date.

Future EEA Phases. The overarching objective of the EEA is to measure the condition of ecological resources in the Marl Prairie/Rocky Glades and the Everglades Ridge and Slough physiographic regions; and to document ecosystem responses as CERP restoration efforts change the quality, quantity, timing and distribution of water, and as State agencies implement control strategies for pollutants such as phosphorus and mercury. EEA employs an integrated, holistic approach in a consistent manner at the landscape level -- the only effort to do so throughout the entire freshwater Everglades ecosystem.

EEA has provided data relevant to 23 CERP performance measures for the Everglades Ridge and Slough and the Marl Prairie/Rocky Glades physiographic regions -- seven for the Greater Everglades, one for the Miccosukee Reservation, three for Everglades National Park, one for soil performance, one for animal performance, five for plant performance and five for hydrological performance. Among these 23 are nine water quality measures.

The monitoring and assessment project has been guided from the outset by the following seven policy-relevant questions which are equally applicable to the four major issues affecting the Everglades ecosystem (hydropattern modification, eutrophication, habitat alteration and mercury

contamination). What is the magnitude of the problem? What is the extent of the problem? Is there a trend? What are the associations with the problem? What are the sources of the problem? What is the risk to the ecological resources? What are the solutions?

In next Phase of the Program, EPA will continue change detection and assessments of:

- concentrations of drivers, including nitrogen, phosphorus, carbon, and sulfur, in water and soil over time and space;
- hydropattem modifications in the system and responses during the wet season;
- soil thickness;
- habitat alterations associated with nutrient loading and hydropattem changes;
- methylmercury contamination;
- mechanisms controlling mercur y methylation;
- bioaccumulation of methylmercury;
- interacting stressors through structural equation modeling; and
- management implications of these issues.

The information will be critical as baseline data for the Central Everglades Planning Project, a new component of CERP that features restoration of the central flow-way.

Methods

Design: The probability design used to sample the Everglades marsh in Phases I - III was developed from the EMAP base grid in order to ensure spatial coverage. The design includes stratification by the four major subareas of the system, the Water Conservation Areas [WCA 1 (also known as Loxahatchee National Wildlife Refuge – LOX), WCA2, and WCA3, and the Park, to ensure that coverage of smaller subareas is adequate for obtaining variance estimates. A consistent sample size of approximately 125 random points per seasonal survey ensures acceptable confidence intervals around estimated environmental parameters. This design criterion is compatible with logistical considerations allowing helicopter- supported crews to complete all sampling in about 15 days, which also matches throughput capacities of cooperating analytical laboratories. In Phase IV, EPA will utilize an improved design that features a mix of new random points and points from the previous Phase. This approach is the only one that produces quantitative statements with known confidence about environmental condition across the entire population over space and time; for example, that the proportion of the Everglades having a total phosphorus concentration greater than 400 mg/kg (the CERP goal) in soil was 49.3 $\pm$ 7.1 % in 2005, and that this proportion is statistically significantly greater than the 33.7 $\pm$ 5.4 % measured in 1995-1996.

Task: EPA will conduct a probabilistic, multimedia, synoptic survey of the entire freshwater flow-way of the greater Everglades ecosystem in the fall of 2013 (Figure 2). This survey will focus on the biogeochemistry of key pollutants in the marsh, namely mercury, phosphorus, and sulfur, in all ecosystem compartments except pore water and benthic macroinvertebrates. These media have been omitted to match the survey effort to available funding.

These surveys depend heavily on the use of helicopters to quickly reach random sampling points scattered throughout the marsh. On an average day, four points can be sampled by one crew. Actual rotor time averages about 2 hours per day over the course of the study. The project is configured for a pair of 3-person crews working simultaneously out of separate helicopters (LongRangers or the equivalent).

The Principle Investigator has applied for a scientific collecting permit from the National Park Service. Permits will also be requested from the U.S. Fish and Wildlife Service and the Miccosukee Tribe of American Indians.

Field Protocols: Crews will obtain samples of surface water, floc, near-bottom water, soil, periphyton, and mosquitofish at each station. In addition, plant association(s) present around the station will be classified at the 2-meter scale, with a total of up to four GPS locations obtained at sub-meter accuracy in the association(s) present.

EPA Region 4 Field Branch SOPs, found at http://www.epa.gov/region4/sesd/fbgstplindex.html, will be followed as applicable. Sediment and floc will be collected in core tubes. A vacuum chamber will be used to collect a clean sample of surface water for trace-level mercury analysis. Periphyton will be collected by direct dipping. Mosquitofish will be collected with an "A"-frame dip-net for analysis of whole-body total mercury. A number of procedures have been developed specifically for the Program over the years. These techniques and equipment, including a new technique under development for collection of near-bottom water for sulfide analysis, will be described in the Quality Assurance Project Plan.

The division of labor among the three-person sampling crews will be approximately as follows. After the first crew member deploys a data-sonde off the port-side pontoon to obtain physicochemical measurements of the water column, the second crew member will exit the aircraft on the starboard side and commence plant classification and related GPS work. The first crew member will then exit the port side to collect water samples, first surface and then near- bottom. The third crew member will handle the sample containers, fill out the field data sheet, and take photographs to document the station and the contents of each core tube. Floc and soil is sampled next, with a GPS fix being obtained at the centroid of the replicate of three soil cores. Measurements of water and soil depth are then obtained, and finally periphyton, mosquitofish, and one culm of sawgrass and cattail (if present) are collected. The second and third crew members will assist the first one in completion of the latter duties as their time allows.

At each station, EPA will measure the parameters listed.

Hydrology and Water Quality: water depth, dissolved inorganic nutrients, dissolved organic C, TP, TC, TN, and chlorophyll a contents. FIU is responsible for laboratory water quality nutrient analyses.

Soil and Floc Quality:	soil and floc type, thickness, bulk density, mineral content, AFDW, pH, TP, TC and TN, SO_4. FIU is responsible for laboratory soil nutrient analyses. A subsample of 25 distributed sites will additionally be analyzed for CO_2 generation and total inorganic C (TIC) content to determine stability of stored C.
Mercury Contamination:	MeHg and THg in surface water, soil, floc, and periphyton; THg in whole-body mosquitofish. FIU is responsible for MeHg and THg analyses. Additionally THg and MeHg in sawgrass sampled from 25 sites.
Habitat Quality:	vegetation mapping using WorldView-2 satellite data (2x2 m pixel resolution, 7 spectral bands) for 1 km^2 centered on the sampling site location. FIU is the lead lab for this.
Ecosystem Integrity:	periphyton cover, bio-volume, biomass, dry weight, AFDW, Chlor a and CNP ratio of periphyton; additionally, periphyton cover for the 1 km^2 around the site location will be estimated in the vegetation mapping.

PRODUCTS

A synthesis report with a CERP management focus, similar to the Phase I, II, and III summary status reports, will be published. Annual reports (lARs) will be submitted by the Principal Investigator. Findings will also be presented at scientific conferences and published on an on-going basis in the peer-reviewed scientific literature. Other products will be as follows:

- All project data will be posted on the internet at http://www.epa.gov/region4/sesd/sesdpub_completed.html and will be available for use to all parties as soon as these data have been through extensive quality assurance/quality control processes.

- A GIS-based data retrieval system will be available through the internet. A prototype of this system was developed for Phase III and is at http://digir.fiu.edu/gmaps/EverMap.php.

- Data reductions, including summary statistical graphics, kriged maps of the data, cumulative distribution functions of estimated environmental parameters, and tests of change detection since Phase III.

- Classified vegetation maps will be produced for a subset of 63 stations, with accompanying data and statistics. Digital data sets and summary descriptive statistics will accompany the maps.

- Estimates of TC, TN, and TP standing stocks for the 63 mapped stations, and estimates of total Hg and methyl Hg for the subset of 25 mapped sites.

- Structural equation models linking stressors, other environmental factors, and responses will be evaluated, recalibrated, and/or adjusted based on the new data. Candidate variables include water depth; chemical constituents (e.g., organic carbon, phosphorus, sulfate, sulfide, total mercury, and methyl mercury) in surface water, floc, soil, and biota such as periphyton and mosquitofish; and metrics of habitat alteration. Structural equation modeling estimates the strength of associations among different variables simultaneously, by evaluating patterns of covariance among them. This tool is useful for examining complex systems such as the Everglades. Projections based on this modeling will provide estimates of what would be expected under different CERP management scenarios including hydropattern restoration and pollutant loading reductions.

The Agreements Technical Representative (ATR) will be responsible for ensuring timely conveyance of deliverables and reports. Further, the ATR will evaluate reports and approve deliverables as appropriate.

BUDGET

The overall budget for a one-pass survey in the wet season of2013 is $700K. EPA will provide $500K in cash, as well as in-kind services (personnel, vehicles, field and analytical equipment, in-house laboratory etc.) which are conservatively estimated as contributing an additional $700K. The EPA has already made a significant investment for the Program in terms of capital equipment, analytical instruments, and methods development over the years. The field sampling team has experience doing this work in the Everglades dating back to 1993. Project personnel are already in place; many of the 90+ people involved last time are still available. The Park's share is $200K (Table 1). The Park's share makes the project possible by funding essential overtime and travel for field crews, as well as equipment and supplies and a portion of contractual expenses.

The overall budget includes all aspects of the project, including field sampling, laboratory analyses, dissemination of project findings, and interpretive reporting for the Park, EPA, and CERP managers and their supporting scientists such as the Technical Oversight Committee and the Task Force Working Group. This budget estimate assumes that participating non-Federal partners would honor reduced overhead rates previously negotiated with the Federal government.

An overhead cost of 9.4% of the overall budget of$200k (= $18.98k) is applied to this project.

Overtime *($27k).* This cover more than 400 hours of anticipated overtime for 22 sample crew members.

Travel *($66k).* Travel cost covers several aspect of the entire sampling mission. *Pilot study and related training ($7.5k):* The pilot study and related training will require 5 days for 10 crew members. *Helicopter training ($24k):* Helicopter training cover 22 crew member (plus 2 back-up members) for 1 week. *Lab audits and scoping ($1.5k):* Lab audits and scoping cost covers two crew members for five days of visits. *Survey ($33k):* The survey will last three weeks, requires 22 EPA crew member split into two teams of 11 over two halves of the mission.

Equipment *($26k).* Equipment required for this mission includes data loggers, soil coring apparatus, near bottom water sampling apparatus, etc.

Supplies *($13.02k).* Supplies used in this mission include sample containers, ultra clean sample containers, water sample tubing, calibration solution, preservatives, etc.

Contracts *($49k).* Quality assurance and statistical support completed by in-house contractors.

Table 1. Budget for extramural funds for the Everglades Ecosystem Assessment Phase IV.

COST		**ENP Share**
	Overtime	$27,000
	Travel	$66,000
	Equipment	$26,000
	Supplies	$13,020
	Contracts	$49,000
Subtotal		$181,020
	Indirect cost rate of 9.49%	$18,980
TOTAL COST		**$200,000**

Figure 1. Everglades Ecosystem Assessment study area. Left: Satellite image of the EEA Program study area. The seven subareas encompass the Everglades Ridge and Slough physiographic region (LOX, WCA2, WCA3-N, WCA3-SE, WCA3-SW, Shark Slough) and the Marl Prairie/Rocky Glades Physiographic region (Shark Slough and Taylor Slough). Right: Locations of the 1145 stations sampled in Phases I - III. Recent Phases have been focused on the main flow-way (the WCAs and the Park).

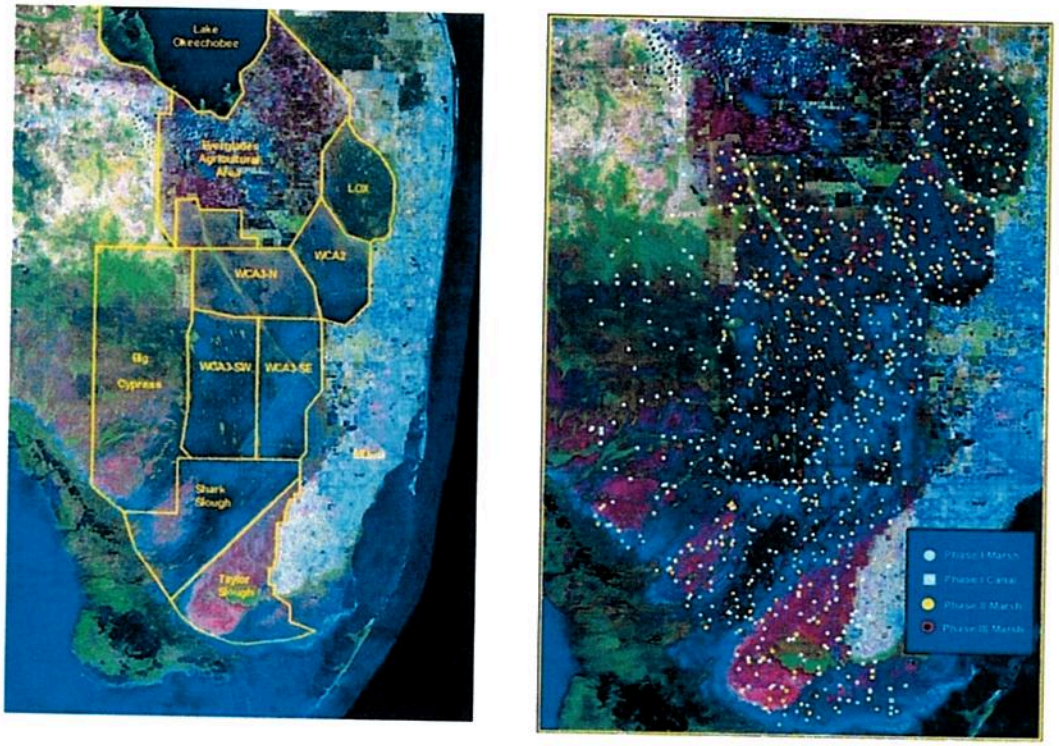

Figure 2. Everglades Ecosystem Assessment Phase IV sites. The Fall 2005 sites are a random subsample of half of the Phase III wet season sites, included for change detection purposes. The Oversample sites are extras to be used as replacements for sites that can't be sampled for various reasons, usually because they fell in or immediately adjacent to a tree island, or in an upland habitat, or because woody vegetation was too dense to enable a safe landing and take-off.